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METHOD FOR DETERMINING GRIZZLY BEAR HABITAT QUALITY AND ESTIMATING CONSEQUENCES OF IMPACTS ON GRIZZLY BEAR HABITAT QUALITY

Stephen P. Mealy

METHOD FOR DETERMINING GRIZZLY BEAR HABITAT QUALITY AND ESTIMATING CONSEQUENCES OF IMPACTS ON GRIZZLY HABITAT QUALITY

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PREFACE

The Endangered Species Act of 1973 (P.L. 93-205) requires that all federal agencies take necessary actions to insure that critical habitat for endangered or threatened species is not (adversely) modified or destroyed (Sec. 7).

Federal agencies are obliged to analyze and review their activities and programs to determine how listed species will be affected (Fish and Wildlife Service, 1976). The method presented here is a response to this obligation.

The objective of the method is to provide an analytic process capable of (1) producing reliable determinations of the quality of proposed land use sites as grizzly habitat, and (2) providing reliable estimates of the effects (consequences) of proposed activities on determined grizzly habitat.

Effects of programs and activities (logging, fire management, road construction, mineral exploration, livestock grazing, recreation and grizzly habitat improvement) on grizzly bear habitat are assumed to be positive, negative, or neutral depending on many variables. This assessment method will facilitate the reliable estimation of consequences of each proposed land use on a site-by-site basis.

Training is intended for those using the method. Individuals or agencies with training needs should contact the Director of Wildlife, Northern Region, U.S. Forest Service, Missoula, Montana.

Edward R. Schneegas
Director of Wildlife
Northern Region
Missoula, Montana

INTRODUCTION

The Forest Service needs a process to evaluate proposed land uses which can affect grizzly bears (Ursus arctos horribilis) and/or their habitat. The process must produce reliable determinations of the grizzly habitat quality of proposed use areas in grizzly range (Figure 1) and reliable estimates of consequences of impacts of proposed land uses on grizzly habitat quality.

This method is based primarily on grizzly habitat quality ratings (HQR) and consequence analysis ratings (CAR) which can provide the needed habitat quality determinations and consequence analysis estimates. HQR are based upon seasonal, on-site determinations of grizzly food, cover, space and behavior quality. CAR are based upon seasonal on-site estimates of consequences of proposed land use impacts upon the quality of habitat (food, cover, space and behavior present) in proposed land use areas.

The habitat evaluation method format, in abbreviated form, is as follows where ratings are symbolized as:

HQR	CAR
H = High	Neg - Negative
M = Medium	Neu - Neutral
L = Low	Pos - Positive
O = None	

	Food		Cover		Space		Behavior		Seasonal Summary	
	FHQR	CAR	CHQR	CAR	SHQR	CAR	BQR	CAR	HQR/BQR	CAR
Spring	____	____	____	____	____	____	____	____	____	____
Summer	____	____	____	____	____	____	____	____	____	____
Autumn	____	____	____	____	____	____	____	____	____	____
Annual Summary	____	____	____	____	____	____	____	____	____	____

The method also includes a search procedure for grizzly sign and activity. Data from these searches are intended to supplement habitat evaluation data.

SURVEY PROCEDURES [1/]

Overview

Extensive and intensive survey areas are designated for proposed land use sites. Primary and secondary land use impact areas are designated within the survey areas. HQR and CAR are based upon data taken in sample plots located in each known grizzly habitat component (Tables 1 and 2) and each other forested habitat type (Pfister et al., 1974) and grassland/shrubland habitat type (Mueggler and Handl, 1974) present in each impact area. Searches for grizzly sign and activity are conducted in impact areas to supplement HQR data.

Survey Areas, Impact Areas, Plot Selection and Sampling

Extensive survey areas are the largest designated in association with proposed land use sites. They include the use sites but extend far beyond them and may encompass one or more townships. They are delineated on 1:62,500 USGS maps. Extensive surveys provide general overviews of the status of grizzly bears and other resources. Off-site analyses of aerial photos, topographic and vegetation maps, land use records, unit plans and other pertinent sources provide general information about topography, vegetation types, climate, wildlife and resource use history.

Intensive survey areas occur within extensive areas, include the proposed land use sites, and may extend beyond them to encompass one or more sections but usually not townships. They are delineated on 1:23,674 USGS maps, aerial photos or orthophotoquads. Intensive surveys provide specific information about proposed land uses and grizzly habitat. The proposed locations of land uses and areas likely to be affected are mapped. Locations of the main grizzly habitat components, activity centers, and use sites near proposed use areas are also accurately mapped. Areas of overlap are highlighted. Appropriate off-site sources for this information are plans of proposed land uses, aerial photos, habitat type maps, unit plans, grizzly activity reports and grizzly habitat studies.

Primary and secondary land-use impact areas are delineated within intensive survey areas on 1:23,674 USGS maps. Primary areas are those in which one or all of grizzly food, cover, space and behavior would be altered directly or indirectly by new uses of the area. Secondary areas are those in which alterations would be possible but much less likely than in primary areas. Sizes of impact areas will vary with terrain and type and duration of each proposed activity.

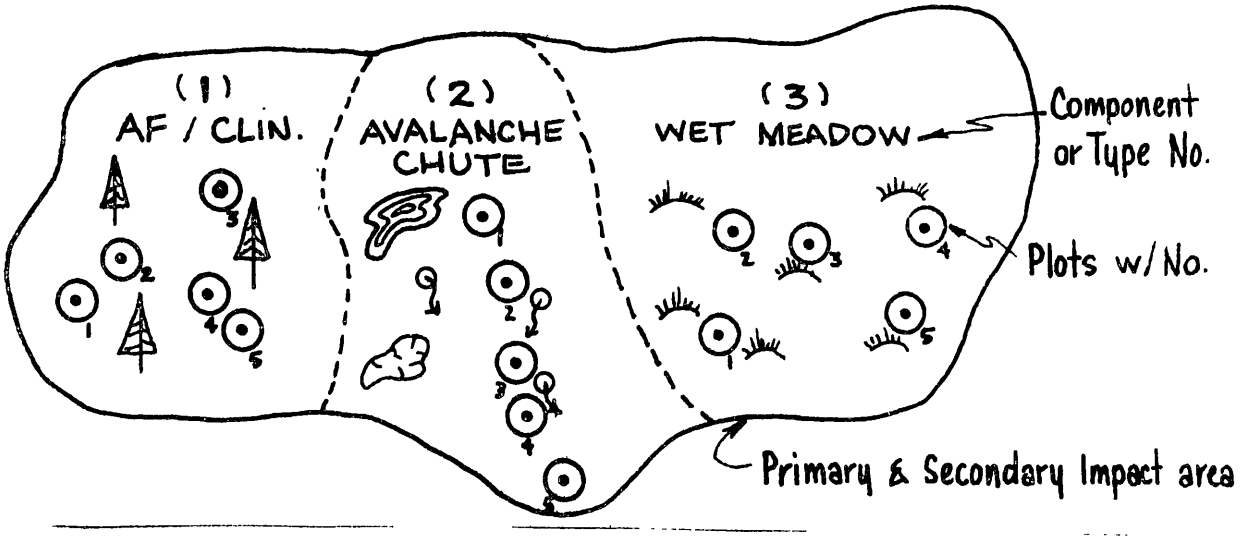
1/ A checklist of survey procedures and a data collection procedure summary are included in the Appendix.

Judgment is necessary in delineating impact areas. Larger areas are appropriate for large-scale uses such as water impoundments and roads, while smaller areas apply to small-scale uses such as dispersed, backcountry recreation sites. Prominent geophysical features (wet sites, talus slopes, etc.), grizzly habitat components and other habitat types determined from on-site and off-site analyses are accurately displayed on maps of primary and secondary impact areas.

Grizzly food and cover are sampled, using the same 1/10 acre circular plots, 2/ in spring, summer and autumn in primary and secondary impact area. Plot sampling procedures follow those of Pfister et al. (1974). Five plots are located and sampled in representative parts of each grizzly habitat component and each other habitat type present in each impact area. If a habitat component or other habitat type is continuous throughout both impact areas it is sampled with only one five plot group distributed through both impact areas. Habitat types not presently identified as grizzly habitat components are sampled to increase the base of data on vegetation types important to grizzlies.

Plot centers in most sample areas are chosen objectively by, for example, pacing pre-determined distances along pre-determined compass courses into habitat components or types. Some habitat components, such as the AF/Luhi/Mefe forested habitat type contain small microsites (pond edges, seeps and springs) which are of greater importance to grizzlies than other parts. These microsites and the habitat components or types proper are each sampled with five plots. Microsites are appropriately described and identified.

SAMPLING AREA DESIGN



Many non-forested areas listed as grizzly habitat components in Tables 1 and 2 can also fit forested habitat type classifications. Non-forested components (such as avalanche chutes and small, wet meadows) occurring as continuous parts of forested habitat types are sampled separately.

2/ See Appendix

Data for food and cover taken from each five plot sample are kept on master Form 1. Individual master forms are maintained for every habitat component and each other habitat type occurring in each impact area. Evaluations of grizzly behavior and spatial use are also made three times a year and are based on considerations of each impact area taken as a whole rather than on sample plots. These evaluations are recorded on Form 2.

Spring samples are normally taken between mid-May and mid-June, depending on local phenology. Sampling occurs before early forbs (Claytonia spp., Ranunculus spp., Anemone spp., Erythronium spp., Fritillaria spp., Dodecatheon spp., etc.) are gone on inconspicuous. Summer plots are sampled when seeds of grasses and forbs are normally ripe and their leaf tips drying and fruits of deciduous shrubs are green. These conditions normally exist (except in very wet sites) in early August. Autumn sampling occurs normally in early October when grasses and forbs in all but wet sites have dry or drying leaves and stems and fruits of shrubs are dry. Seasonal sampling facilitates the determination of availability and use of food, cover and space.

A search for grizzly sign and activity is conducted in primary and secondary impact areas. Grizzly sightings, tracks, scats, diggings, hair and other sign are reported on Forms 4 and 5.

Search for Grizzly Sign and Activity

Searches for grizzly sign and activity are conducted in spring, summer and autumn as part of the overall evaluation process. Searches are conducted from the ground in primary and secondary impact areas. Ground searches may be supplemented by aerial surveys if feasible.

Ground searches should be systematic. A recommended method involves the establishment of permanent walking routes. Routes are laid out in a grid configuration with a constant interval between routes. Intervals should be spaced to give representative coverage of impact areas. Care should be taken to include the more important habitat component (avalanche chutes, burns, wet meadows, etc.) in survey routes. Routes are walked at least once, but as many times as feasible, each season.

Grizzly sightings, tracks, diggings, hair, dens and other sign noted along routes are reported on Forms 4 and 5. Grizzly scats are also collected, analyzed, and the contents reported. Basic references are: Murie (1954), for species, track and scat identification; Tisch (1961) and Mealey (1977), for scat identification and analysis; Greer and Craig (1971), for track identification; Spence (1963), for hair identification and Craighead and Craighead (1972) and Knight et al. (1977) for dens.

Biological Requirements and Characteristics: Food, Cover, Space and Behavior

Food

Habitat Quality Determination

Food habitat quality is determined by identifying the value of each habitat component or type as a producer of grizzly bear foods. Quality is expressed by a seasonal food habitat quality rating (FHQR).

FHQR is a value which includes considerations of total occurrences, total coverage and food value of grizzly food plants on sample plots and presence and food value of animal material anywhere in areas represented by sample plots.

Total occurrence equals the total number of bear food plant species in the five plot sample in each habitat component or type. It is determined by adding the total entries for an evaluation period in the TOT. and AVG. column on Form 1. Species totals are translated into letter values using the conversion system in Note 1, Form 1.

Coverage for each species equals the canopy coverage by each species of each plot. Average coverage is the sum of individual species coverage values over the five plot sample, divided by five. Total coverage is the sum of the average coverage values of all bear food species in each habitat component or type. Total coverage percents are converted into letter values using the conversion system in Note 2, Form 1.

Food value is a function of seasonal food quality, production and use. Letter values for food quality of food groups during different seasons are as represented in Note 3, Form 1. Plant food values are applied to the food group present with the highest canopy coverage sub-total and the highest food value in the season of measurement.

Animal material includes elk, deer (Odocoileus spp.), moose (Alces alces), fish and rodents occurring alive or as carrion anywhere in areas represented by each group of five plots. Direct evidence can be droppings, tracks, visual sightings, casts, burrows, antler rubs, wallows and travel routes. Indirect evidence can be records of use (such as for wintering and calving grounds, and for fish spawning habitat). Before animal material food value is recorded as either H or M (Note 3, Food Group 5, Form 1) direct or indirect evidence must be available establishing the probability or likelihood of grizzly food use of the material.

When animal material is present, FHQR equals the sum of the letter values for animal material food value and total occurrence, total coverage and food value of food plants where H = 3, M = 2, L = 1 and 0 = 0. Sums become letter values according to the following conversions: 0-4 = L, 5-8 = M and 9-12 = H. For example, assume animal material is H, total occurrence is L, total coverage is H and food value is 0; the sum is 7 so FHQR = M. When animal material is absent, FHQR equals the sum of the letter values for total occurrence, total coverage and food value of food plants where H = 3, M = 2, L = 1 and 0 = 0. Sums become letter values by the following conversions: 0-3 = L, 4-6 = M and 5-9 = H.

When FHQR = H, food habitat quality is high; when FHQR = M, food habitat quality is medium; when FHQR = L, food habitat quality is low; and no food habitat quality exists when FHQR = 0.

Consequence Analysis Estimation

Consequence analysis rating (CAR) involves estimation of the probable or necessary effects of proposed land use impacts on the quality of grizzly food on all five plots taken as a group or whole and the area represented by them. Consequences are estimated by (1) identifying all probable impacts of proposed land uses on each component's or type's FHQR including plant and animal foods and the soils which support them, and (2) estimating the probable effects of the impacts upon food and soils.

CAR are based upon estimates of (1) desirable species (see ecology section) and other grizzly food plant's and animal's probable responses to different proposed land uses, (2) the likelihood of soil disturbances, and (3) probable food availability to bears.

CONSEQUENCE ANALYSIS SYSTEM - FOOD

FOODS
CONSEQUENCE ANALYSIS

PLANT & ANIMAL FOOD RESPONSES

AVAILABILITY OF FOOD

AFFECTED BY:
- FIRE
- TIMBER
- LIVESTOCK
- MINING
- ROADS
- RECREATION

RATING

NEGATIVE - PLANT & ANIMAL FOOD SYSTEM DEGRADED

NEUTRAL - PLANT & ANIMAL FOOD SYSTEM MAINTAINED

POSITIVE - PLANT & ANIMAL FOOD SYSTEM ENHANCED

Rating categories are as follows:

Neg. = Negative effect on food habitat quality (FHQR). The likelihood is great that (1) most of the bear food plant species in the habitat component or type (treating all plots as a whole) would decrease, or (2) food species (plants and animals) would otherwise become unavailable to bears at critical times. Any or all of the following conditions could apply:

(a) Soil - Soils would be broken, scarified, exposed or overturned.

(b) Water - Water-table and/or drainage patterns would be altered resulting in too much or too little water.

(c) sunlight - When combined with soil disturbance, sun exposure, through total overstory removal, would favor "heliophytic" (sun-loving) intermediates and least desirables over the more "sciophytic" (shade-loving) desirables.

(d) Plants and Animals - Food plant root systems would be exposed, removed or overturned. Animals and plants would become unavailable as food to bears through either direct use and/or removal by other consumers (livestock, wildlife and man) or other activities which would interfere with grizzly access to or use of food plants and animals.

Neu. = Neutral effect on food habitat quality (FHQR). Most bear food plants would likely be unaffected by the proposed activity. None of the above conditions (a-d under Neg.) would apply.

Pos. = Positive effect on food habitat quality (FHQR). Conditions favoring food plant and animals would be initiated or enhanced. Any or all of the following conditions could apply:

(a) Soil - Soil stability and healing would be enhanced without soil disturbance.

(b) Water - Water supply would be altered to benefit desirables.

(c) Sunlight - Sun exposure would be altered (slightly increased through partial overstory removal) without soil disturbance, benefiting desirables.

(d) Plant and Animals - Conditions for increasing, re-establishing and/or invigorating grizzly foods would be initiated or improved. Availability of food to bears would be increased by removing interference factors and/or other consumers.

POSITIVE, NEUTRAL AND NEGATIVE EFFECTS COULD ALL CONCEIVABLY RESULT FROM IMPACTS ON THE SAME PROPOSED LAND USE SITE. PROFESSIONAL JUDGMENT AND DISCRETION ARE NECESSARY IN ORDER TO RELIABLY ESTIMATE THE DOMINANT CONSEQUENCES AND CHOOSE A CAR WHICH REFLECTS THEM. GENERALLY A CONSERVATIVE APPROACH IS DESIRABLE. FOR EXAMPLE, ONE SEVERE NEGATIVE EFFECT MAY OFFSET TWO OR MORE POSITIVE EFFECTS. THE EFFECT OR GROUP OF EFFECTS WHICH WILL EXERT THE MAJOR INFLUENCE ON GRIZZLY USE OF THE SITE WILL RECEIVE THE GREATEST CONSIDERATION IN CAR.

The appropriate food habitat quality CAR value is placed in the blank opposite FHQR on Form 1. VERBAL RATIONALE FOR THE RATING, INCLUDING MAGNITUDE AND DURATION OF LIKELY EFFECTS IS GIVEN ON FORM 3.

Cover

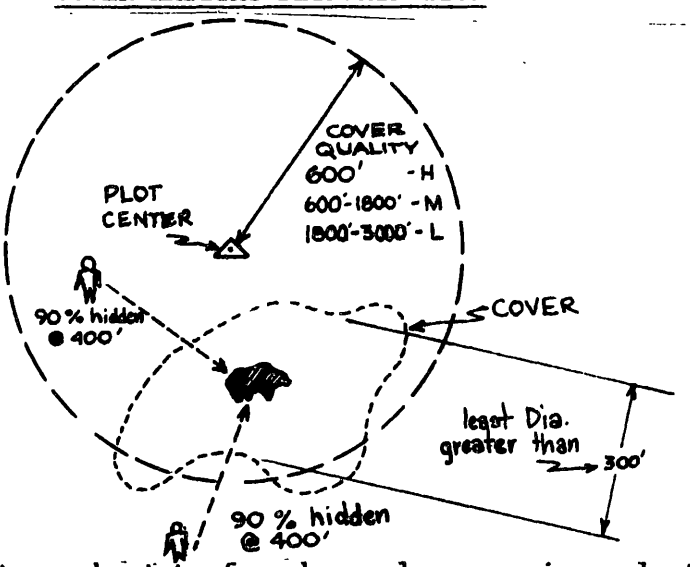
Habitat Quality Determination

Cover habitat quality is determined by identifying each habitat component's or type's value in providing for the denning and security or hiding needs of grizzlies. Quality is expressed by a seasonal cover habitat quality rating (CHQR).

The same sample plots used to assess FHQR are used to determine CHQR. Cover is evaluated as it relates to food because cover is believed to have its greatest value to grizzlies when it facilitates efficient food use. Thomas et al. (1976) used a similar approach in assessing elk food/cover relationships.

Cover is defined as vegetation and/or topography which hides 90 percent of a grizzly from the view of a person 400 feet away. Cover should have a least diameter of 300 feet or greater. (Definition adapted from Thomas et al., 1976).

COVER HABITAT DETERMINATION



Cover in relation to each plot of each sample group is evaluated using the following criteria:

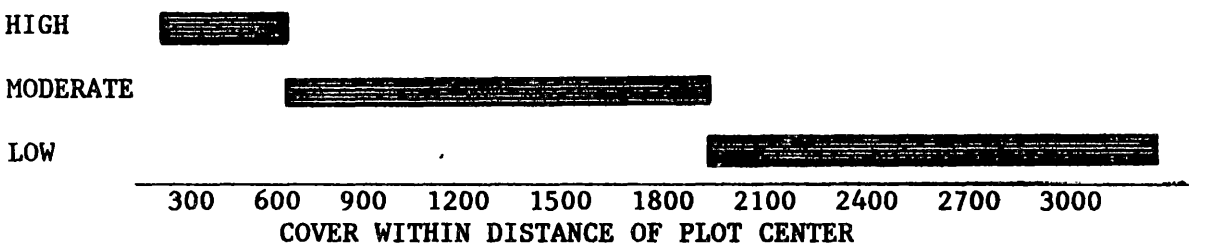
CHQR = H; cover habitat quality is high when cover occurs within 600 feet of plot center.

CHQR = M; cover habitat quality is medium when cover occurs between 600 and 1,800 feet of plot center.

CHQR = L; cover habitat quality is low when cover occurs between 1,800 and 3,000 feet from plot center.

CHQR = 0; no cover habitat quality exists when cover is absent within 3,000 feet of plot center.

COVER HABITAT QUALITY



CHQR equals the sum of individual plot (chqr) ratings P-1 + P-2 + P-3 + P-4 + P-5, where H = 3, M = 2, L = 1 and 0 = 0. Sums become letter values according to the following conversions: 0-5 = L, 5-10 = M and 10-15 = H. For example, assume the following chqr values: 0, H, H, M, and L for P-1 through P-5 respectively. The sum is 9 so CHQR = M.

When CHQR = H, cover habitat quality is high; when CHQR = M, cover habitat quality is medium; when CHQR = L, cover habitat quality is low; and no cover habitat quality exists when CHQR = 0.

If a denning area is known or suspected to occur in areas represented by each sample group, yes should be written in the blank under CHQR in Form 1. Other observations should be given as appropriate in the space provided for other comments.

Consequence Analysis Estimation

CAR requires the estimation of the probable or necessary effects of proposed land use impacts on CHQR or cover value of vegetation and topography on all plots taken as a whole and the area represented by them. This involves (1) identifcation of all probable land use impacts, (2) estimation of probable cover plant responses to probable impacts, and (3) estimation of the extent of probable changes in landscape.

CONSEQUENCE ANALYSIS SYSTEM

COVER VALUE

COVER PLANT MODIFICATION RESPONSES TO

LANDSCAPE MODIFICATION RESPONSES TO

Impacts of:
- FIRE
- TIMBER
- LIVESTOCK
- MINING
- ROADS
- RECREATION

RATING

NEGATIVE - PLANT & LANDSCAPE COVER WOULD DECREASE

NEUTRAL - PLANT & LANDSCAPE COVER WOULD BE MAINTAINED

POSITIVE - PLANT & LANDSCAPE COVER WOULD BE ENHANCED

Rating categories are much the same as for food CAR because most cover vegetation, including herbs and shrubs, will respond negatively to severe mechanical soil disturbances. Conifer regeneration is favored by scarification, but overall site food quality is lowered. Categories are as follows:

Neg. = Negative effect on cover habitat quality (CHQR). Most trees, shrubs and tall herbs providing cover would decrease. Landscape would be altered to reduce cover quality. The following effects would apply.

(a) Topography - Relief would be altered or otherwise interfered with to reduce its qualities for escape and security.

(b) Soil - Soil would be exposed.

(c) Water - Water sources would be detrimentally altered.

(d) Plants - Cover plants, including root systems, would be removed, overturned or otherwise disturbed and/or cover plants would become unavailable to bears through activities which would interfere with grizzly access to them.

Neu. = Neutral effect on cover habitat quality (CHQR). Cover would be unaffected by the proposed activity. None of the above conditions (a-d under Neg.) would apply.

Pos. = Positive effect on cover habitat quality (CHQR). Conditions favoring cover plants and relief would be initiated or improved. One or all of relief, soil, water, sunlight and plant influences on cover would be improved.

The appropriate cover habitat quality CAR value is placed in the blank opposite CHQR on Form 1. If dens or densities are present or suspected, likely effects of impacts are indicated in the space provided below CHQR opposite denning area on Form 1. Consequence stratification rationale should be included on Form 3 as appropriate.

Space

Habitat Quality Determination

Spatial Habitat quality is determined by identifying each impact area's value as part of the total space used by an individual or population of grizzlies. Quality is expressed by seasonal space habitat quality rating (SHQR).

SHQR is a value which expresses the quality of an impact area as part of a total grizzly use system. Quality is evaluated using the following criteria:

SHQR = H; space habitat quality is high when the impact area is part of a grizzly use system which contains a resident grizzly or a resident population of grizzlies and the following conditions apply: The area containing the system should be large enough to encompass all the habitat components deemed necessary for grizzlies. These habitat components often occur in remote, protected or nonprotected situations in the same general area. They are often isolated or separated by substantial distances, but serve as interacting parts of a grizzly use system. Small isolated, seasonably-important areas not within the same general area as above, but within the same region and available to individual bears are also included. The system includes specific geographic units such as mountain ranges, drainages or certain definable parts thereof.

SPACE HABITAT QUALITY DETERMINATION

LOW QUALITY

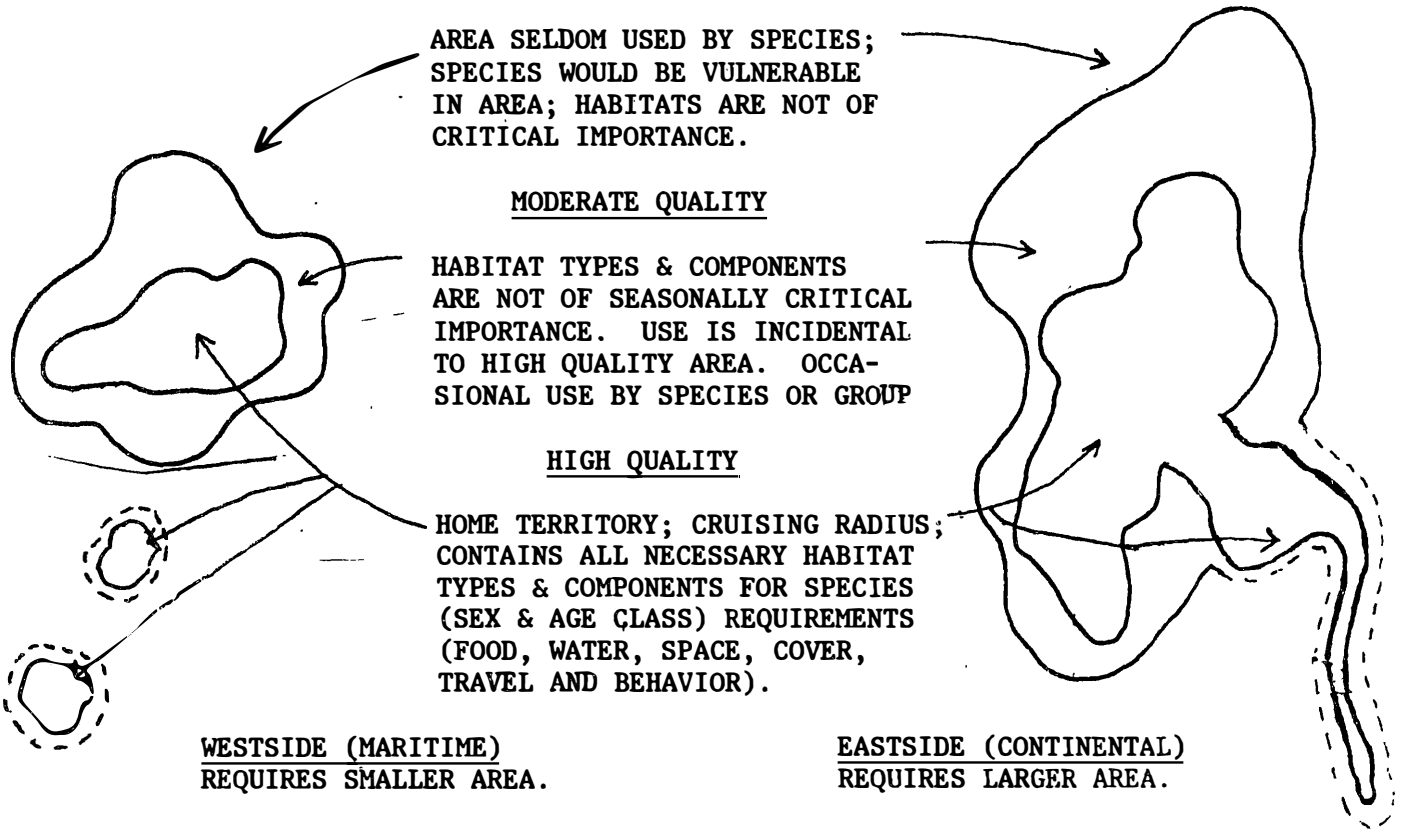
AREA SELDOM USED BY SPECIES; SPECIES WOULD BE VULNERABLE IN AREA; HABITATS ARE NOT OF CRITICAL IMPORTANCE.

MODERATE QUALITY

HABITAT TYPES & COMPONENTS ARE NOT OF SEASONALLY CRITICAL IMPORTANCE. USE IS INCIDENTAL TO HIGH QUALITY AREA. OCCASIONAL USE BY SPECIES OR GROUP

HIGH QUALITY

HOME TERRITORY; CRUISING RADIUS; CONTAINS ALL NECESSARY HABITAT TYPES & COMPONENTS FOR SPECIES (SEX & AGE CLASS) REQUIREMENTS (FOOD, WATER, SPACE, COVER, TRAVEL AND BEHAVIOR).



WESTSIDE (MARITIME)
REQUIRES SMALLER AREA.

EASTSIDE (CONTINENTAL)
REQUIRES LARGER AREA.

SHQR = M; space habitat quality is medium when the impact area is at the "outer edges" of a high quality area. The area may serve as a buffer between high and lower quality area (Erickson, 1976, 1975) and may contain one or more important habitat types or components, but none that are of critical seasonal importance such as early green-up areas. The area may be used occasionally by an individual grizzly or a population of grizzlies from a high quality area.

SHQR = L; space habitat quality is low when the impact area is at the extreme outer fringe of a medium quality area. The area may be considered marginal in the sense that individual grizzlies may be highly vulnerable to established and legitimate uses. The area may contain one or more habitat components but none of critical seasonal importance. The area is seldom used by grizzlies.

SHQR = 0; no space habitat quality exists when impact areas are not associated with an established grizzly use system and no grizzly habitat components occur.

SHQR = HX; characteristics of H are present but grizzlies do not occur in the area (potential range).

SHQR = MX; characteristics of M are present but grizzlies do not occur in the area (potential range).

SHQR = LX; characteristics of L are present but grizzlies do not occur in the area (potential range).

After the appropriate SHQR is chosen, the value is entered in the blank under SHQR on Form 2.

Consequence Analysis Estimation

CAR requires the estimation of the probable or necessary effects of proposed land use impacts on SHQR or the impact areas and the use systems of which they are a part. This requires (1) identification of all probable activities and their probable impacts, and (2) estimation of effects of impacts upon spatial quality and the components which make it up.

CONSEQUENCE ANALYSIS SYSTEM - SPACE

SPACE VALUE

IDENTIFY PROBABLE ON-SITE & OFF-SITE ACTIVITIES.

ESTIMATE EFFECTS OF IMPACTS ON SPATIAL QUALITY.

IMPACTS OF:
- FIRE
- TIMBER
- LIVESTOCK
- MINING
- ROADS
- RECREATION

RATING

NEGATIVE - ACTIVITIES THAT WOULD CAUSE THE SPECIES TO AVOID AN AREA IR CINE UB CIBFKUCT WUTG NAB,

NEUTRAL - ACTIVITIES THAT WOULD NOT CAUSE A SPECIES TO AVOID AN AREA.

POSITIVE - ACTIVITIES OR MANAGEMENT THAT WOULD ENHANCE HABITAT QUALITY AND REMOVE OR RESTRICT ACTIVITIES CAUSING SPECIES TO AVOID AREA.

Rating categories are as follows:

Neg. = Negative effect on space habitat quality (SHQR). Any negative effect recorded for food (FHQR) and/or cover (CHQR) probably constitutes a negative effect here. In addition, any other activities which would likely end or seriously interfere with or disrupt use of an area by grizzlies probably constitutes a negative effect. Such acitivities could include, but not be limited to, housing subdivisions, transportation and recreation uses including trails, roads, cross-country snow courses and ORV activity. Human activities which may or may not cause physical site alterations but could cause grizzlies to avoid use areas because of excess noise and visual disturbances, or increase opportunities for grizzly-human conflict, would cause negative effects.

Neu. = Neutral effect on space habitat quality (SHQR). Space would be unaffected by the proposed activity.

Pos. = Positive effect on space habitat quality (SHQR). Any positive effects recorded for FHQR and/or CHQR probably constitute positive effects. Any other general benefits or enhancements of conditions for grizzlies resulting from the use (such as removal of pre-existing negative factors through, for example, road closures and removal of garbage facilities or other human developments) would apply here.

The appropriate space habitat quality CAR value is placed in the blank SHQR on Form 2. A verbal stratification of consequences is entered on Form 3.

Behavior

Behavior Quality Determination

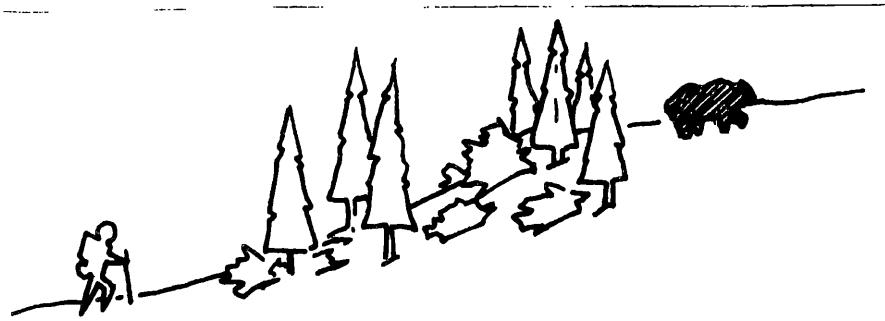
Behavior quality determination involves identification or estimation of the general predisposition of grizzlies in each impact area to man and to natural foods. Behavior quality is expressed by a seasonal behavior habitat quality rating (BHQR).

BHQR is a value which expreses (1) the extent to which grizzly behavior in impact areas is pristine or modified with respect to food use and man, and (2) likely human-grizzly conflict potential in impact areas assuming accepted measures of food storage and garbage disposal are used. BHQR are made using the following criteria:

BHQR = H; behavior quality is high when behavior in impact areas is essentially pristine. No grizzlies are habituated to man and all flee in most encounter situations. Conflict potential is low. Natural foods are used exclusively by all individuals under free-ranging conditions.

HIGH BEHAVIOR QUALITY

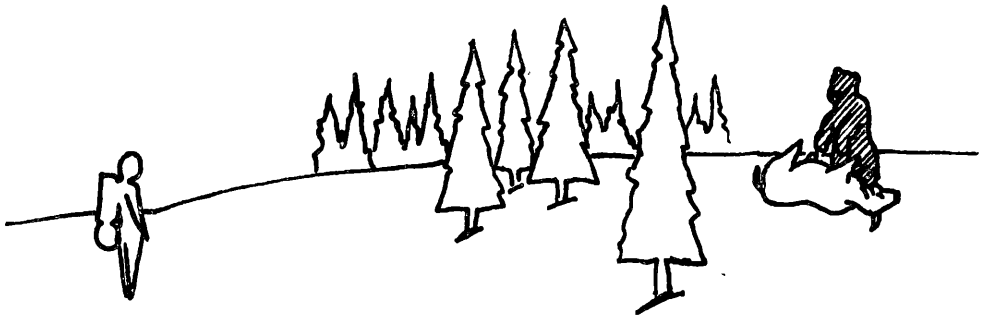
BEAR IS NOT HABITUATED TO MAN: NATURAL FOODS ARE USED: MOST BEARS FLEE MAN ON ENCOUNTERS; CONFLICT POTENTIAL IS LOW.



BHQR = M; behavior quality is medium when behavior of some individuals is modified but all remain essentially non-habituated to man. Conflict potential is low to moderate. Foods are primarily natural items taken under free-ranging conditions, although some individuals occasionally use foods associated with man, such as domestic livestock carrion and black bear baits which are used in Wyoming.

MODERATE BEHAVIOR QUALITY

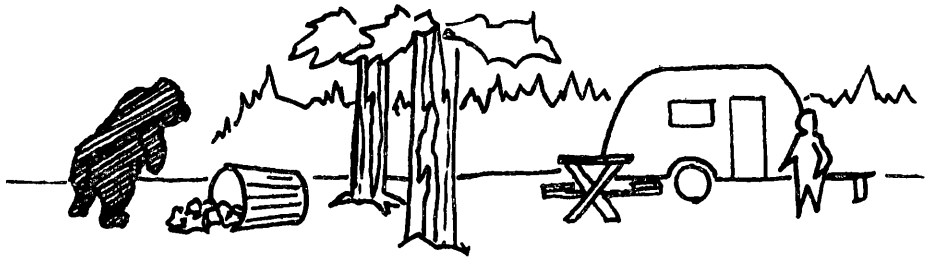
BEAR IS NOT HABITUATED TO MAN; FOODS ARE PRIMARILY NATURAL ITEMS, ALTHOUGH SOME INDIVIDUALS OCCASIONALLY USE FOODS ASSOCIATED WITH MAN (i.e. DOMESTIC LIVESTOCK CARRION). CONFLICT POTENTIAL IS LOW TO MODERATE.



BHQR = L; behavior quality is low when behavior of two or more individuals is modified and they are habituated to man. Conflict potential is moderate to high. Unnatural foods (garbage, camp groceries, and livestock) are used extensively by some, and the occurrence of such foods strongly influences distribution.

LOW BEHAVIOR QUALITY

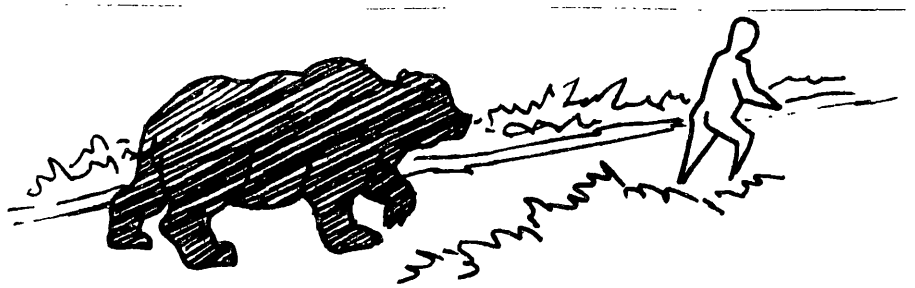
BEAR IS HABITUATED TO MAN: FOODS ARE PRIMARILY OF UNNATURAL SOURCES (i.e. GARBAGE, GROCERIES, LIVESTOCK CARRION, ETC.); OCCURRENCE OF SUCH FOODS INFLUENCES SPECIES DISTRIBUTION; CONFLICT POTENTIAL IS MODERATE TO HIGH.



BHQR = 0; no behavior quality exists when behavior of two or more is modified to the extent that individuals are totally habituated to man and they have no fear of man. Conflict potential is extremely high. Unnatural foods are depended upon and such foods are agressively pursued and taken wherever they occur.

AGGRESSIVE BEHAVIOR QUALITY

TOTALLY HABITUATED TO, AND HAVE NO FEAR OF, MAN; DEPENDENT ON AND AGGRESSIVELY PURSUE UNNATURAL FOODS; CONFLICT POTENTIAL IS EXTREMELY HIGH.



The appropriate BHQR value is entered in the blank under BHQR on Form 2.

Consequences Analysis Estimation

CAR requires estimation of the probable or necessary effects of proposed land use impacts on BHQR or the dominant behavior patterns apparently characteristic of the population or individuals in each impact area. Ratings reflect the extent to which land uses would likely affect existing behavior patterns.

CONSEQUENCE ANALYSIS SYSTEM - BEHAVIOR

BEHAVIOR VALUE

PREVAILING BEHAVIOR PATTERN OF POPULATION IN IMPACT AREA.

EXTENT OF EFFECT IMPACT WOULD HAVE ON BEHAVIOR.

IMPACTS OF:
- FIRE
- TIMBER
- LIVESTOCK
- MINING
- ROADS
- RECREATION

RATING

NEGATIVE - AT LEAST ONE GRIZZLY WOULD BECOME HABITUATED TO MAN BY: DISRUPTION OF NATURAL FOOD SUPPLY; INTRODUCTION OF UNNATURAL FOODS; CONCENTRATING MAN IN AREAS PROVIDING NATURAL FOOD SOURCES OF HIGH DEMAND BY BEAR.

NEUTRAL - NO EFFECTS ON BEHAVIOR.

POSITIVE - AT LEAST ONE GRIZZLY WOULD BECOME LESS HABITUATED TO MAN BY: ENHANCEMENT OF NATURAL FOOD SUPPLY; PERMANENT REMOVAL OF UNNATURAL FOOD SUPPLY; REMOVE HIGH GRIZZLY-HUMAN CONFLICT POTENTIALS.

Rating categories are as follows:

Neg. = Negative effect on BHQR. Behavior of at least one grizzly would become modified to make it more habituated to man while no individuals would be made less habituated. This could occur through:

(1) Disruption of normal food use patterns including food plant destruction and interference with use of normal feeding sites;

(2) Introduction of and improper storage of unnatural food items and improper disposition of waste or garbage; this includes leaving dead livestock on open range to decompose or be eaten by wildlife;

(3) High human concentrations in high grizzly use feeding areas (berry patches) causing aggressive bear responses or pursuit of less natural foods.

Negative CARs against FHQR, CHQR and SHQR might warrant negative ratings against BHQR.

Neu. = Neutral effect on behavior habitat quality. Behavior would be unaffected by the proposed activity.

Pos. = Positive effect on behavior habitat quality. Behavior of at least one grizzly would become modified to make it less habituated to man while no individuals would be made more habituated. This could occur through:

(1) Enhancement of natural food use patterns and enhancement of habitat components providing food and cover;

(2) Permanent removal of unnatural food sources;

(3) Amelioration of conditions contributing to high grizzly-human conflict potential.

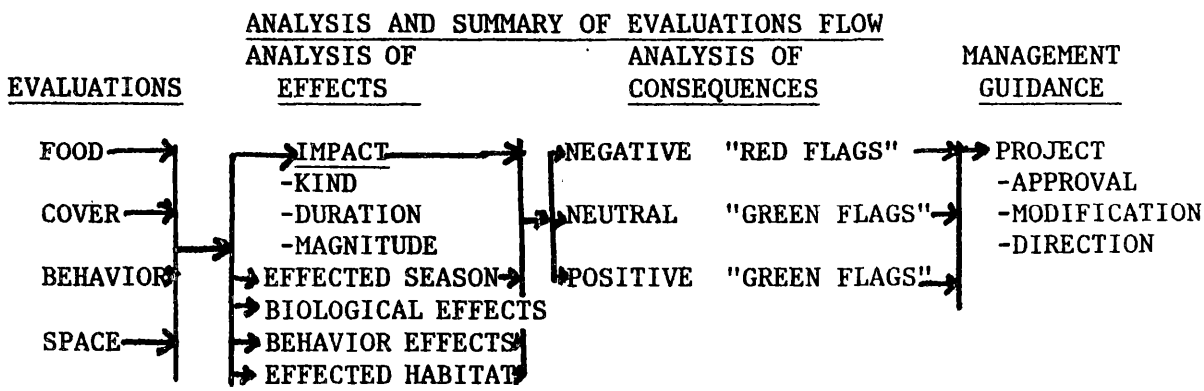
The appropriate behavior quality CAR value is placed in the blank under BHQR on Form 2. A verbal stratification of consequences is entered on Form 3.

SURVEY ANALYSIS

Summary information from data masters (Forms 1 and 2), representing habitat components and types evaluated in impact areas of proposed land use sites is transferred to corresponding summary scorecards (Form 6). Scorecards are grouped by impact areas and then by habitat components (Tables 1 and 2) and other habitat types within impact areas. Grizzly sighting and sign information (Forms 4 and 5) is included in the comments section of scorecards representing the component or type in which the activity or sign was noted.

Information on individual scorecards is summarized in the blanks provided when this can be meaningfully done. Generally, information from one scorecard should not be added to that of another. The system was not designed to produce totals yielding automatic decisions.

The relationships in each component or type between habitat quality and consequences should be carefully considered separately. Only after this has been done for each component or type should all scorecard information be put together into an analytic mosaic of the proposed use site. No single indicator should be looked to for finite answers at this overview level. Instead, general trends in relationships should indicate (1) the kind, magnitude and duration of probable impacts, (2) which season or seasons their probable effects would be most likely, (3) which of the grizzly's biological and behavioral needs would be most affected, and (4) which habitat components and types would be involved.



Consequence analysis ratings are not in themselves decisions. Negative ratings are mainly alerts or "red flags" which signal specific needs for and directions of project modification if proposed activities are to be pursued. Taken together, consequence ratings provide a thorough and reliable means of identifying how grizzlies and/or their habitat would likely be affected by alternative land uses. Such identification can facilitate an improved process of deciding among land use alternatives where grizzly preservation is a high priority.

REVIEW OF GRIZZLY ECOLOGY

FOOD

General

Food consists of all materials providing for the nutritional needs of the grizzly. With respect to food, grizzlies use diverse habitats. Grizzlies west of the continental divide in northwestern Montana and in the Yellowstone Park area and elsewhere along and east of the continental divide in Montana appear to represent two distinct groups, each occupying a different primary nutrient niche. (A primary nutrient niche refers to the relationship between grizzlies and the single nutrient from which most energy is derived during the year.)

Grizzly range west of the continental divide in northwestern Montana and northern Idaho includes primarily mountainous areas with a maritime climatic influence. Grizzlies in this range appear to derive most of their energy from sugar occurring in the fleshy fruits of huckleberry (Vaccinium spp.), mountain ash (Sorbus spp.) and buffaloberry (Shepherdia canadensis); burns producing these fruiting shrubs are the primary feeding areas (Husby et al., 1977; Mealey et al., 1977; Hamlin and Frisina, 1974; Martinka, 1972; Shaffer, 1971 and Tisch, 1961). Before and after shrublands produce fruit, the diet is probably dependent upon protein from succulent herbs and starchy underground plant parts which occur primarily in non-forested habitat components including avalanche chutes, sidehill parks, wet meadows, stream bottoms and other moist sites (Husby et al., 1977; Mealey et al., 1977). These components probably entirely replace shrublands as energy sources during years when fruits fail or in areas which lack fleshy fruit-bearing shrubs.

Grizzly range in the Yellowstone Park area and elsewhere along and east of the continental divide in Montana is more open and more xeric with a continental climate. Here, grizzlies derive most of their energy from protein in succulent, herbaceous vegetation, primarily grasses and sedges and secondarily the aerial parts of western springbeauty (Claytonia lanceolata), elk thistle (Circium foliosum) and clover (Trifolium spp.) (Mealey, 1977). Starch, from the underground parts of springbeauty (Claytonia spp.) and biscuitroot (Lomatium spp.) is also used in significant amounts (Sumner and Craighead, 1973; Mealey, 1977). Moist, fertile grasslands, herblands, stream bottoms, ridgetops, talus slopes and wet avalanche chutes, all interspersed with timbered areas, are the primary feeding sites and their locations appear to influence population distribution. In Yellowstone Park and on the Scapegoat Plateau, these components are used between 5,000 and 10,000+ feet, depending upon season and phenology (op. cit.).

West of Continental Divide

Table 1 shows gizzly food use as indicated by analysis of scats collected in 1975 and 1976. Fruits and berries were the diet mainstays. Stems and leaves of succulent grasses, sedges and Umbelliferae were also important. Grizzly food species and habitat components are as indicated in Table 1. Extensive definitions of habitat components and discussions of management implications are available in the references provided.

Husby et al. (1977), Mealey et al. (1977), Craighead et al. (1976), Erickson (1976 and 1975), Sumner and Craighead (1973) and Martinka (1972) provide data for the following summary. Succulent, new grass is the earliest and most important food used by grizzlies in spring following their emergence from dens. Some carrion and whitebark pine (Pinus albicaulis) nuts from from caches are also used at this time. Grasslands on south and southwest facing slopes (sidehill parks) with early green-up, and snow-free, wet meadows and riparian edges are the primary feeding sites. In early June, grizzlies begin to feed on succulent herb tops (Umbelliferae). Feeding sites are primarily south slope avalanche chutes. In late June and early July, Umbelliferae tops and starchy roots of springbeauty and glacier lily (Erythronium grandiflorum) are eaten in north slope avalanche chutes and in other moist micro-sites in mesic forested habitat types including AF/Caca and AF/Luhi/Mefe. These north aspect and other mesic sites follow south slope avalanche chutes phenologically by three to four weeks. From mid-July to mid-September the primary foods in most of the region are huckleberries and buffaloberries which are eaten primarily in burns. On the Scapegoat Plateau the primary food during the same time are roots and corms. Stream bottoms, wet meadows and moist micro-sites, especially those with western sweetroot (Osmorhiza occidentalis) in the AF/Luhi/Mefe and AF/Clun forested habitat types, also provide succulent herbs as food. From late September to late October the primary food is the fruit of mountain ash which occurs in burns, avalanche chutes, snowfields and some logged sites. This food is supplemented by succulent herbs, which are generally uncommon at this time, and starchy roots taken on ridgetops. Food, from late October to denning in late November, consists of kinnikinnick (Arctostophylos uva ursi) which is eaten in old burned areas, starchy herb roots which are used on ridgetops and flood plains and succulent herbs which are eaten in very moist micro-sites.

Yellowstone Park, Along and East of Continental Divide

Grasses and sedges were the primary foods used by grizzlies in Yellowstone Park in 1973 and 1974 (Table 2). Analyses of scats collected in 1975 and 1976 in and around the park has indicated a continuing trend in the use of grasses and sedges as primary foods. Springbeauty, elk thistle and clover are other important foods, although far less significant than grass and sedge. Grizzly food species are listed, as are grizzly habitat components (Table 2).

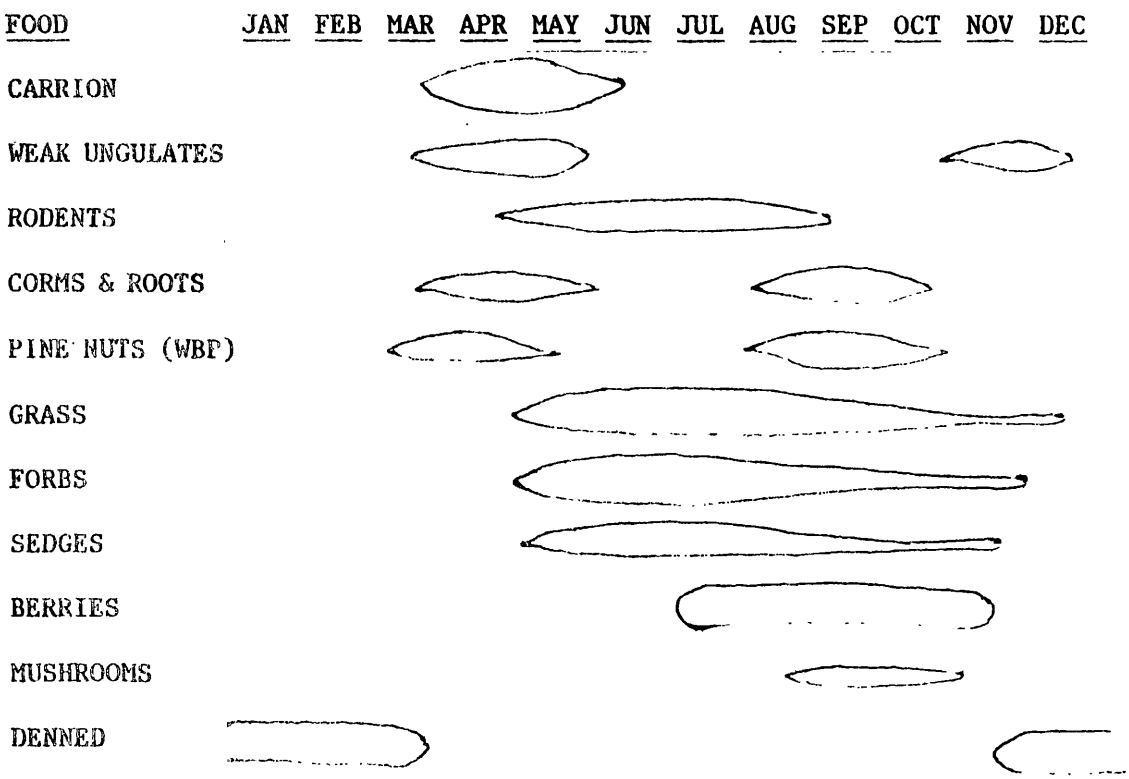
Grizzly use in relation to all the habitat components given, especially the forested types, has not been well documented. The forested types are inferred to be important primarily because of their moisture characteristics and the foods present.

Valley/plateau grassland/herblands (prairie) and subalpine grassland/herblands (park) have been described by Houston (1976), Craighead and Craighead (1972), Meagher (1973), Despain (1973), Gruell (1973), Mealy (1977) and Holdorf (1975). Excellent photographs of typical sites in the Yellowstone Park area are contained in Houston (1976) and Gruell (1973). Valley/plateau grassland/herblands in Yellowstone Park generally fit the Feid/Deca, Arca/Feid, and Feid/Agca grassland/shrubland habitat types (Graham, 1977). On the Lewis and Clark National Forest along the Rocky Mountain front, grassland/herbland fit the Pofr/Fesc, Fesc/Feid and Fesc/Agsp grassland/shrub-land habitat types (Schallenberger, 1976). Subalpine grassland/herblands important to grizzlies in both areas appear to fit the Deca/Carex and Feid/Deca habitat types.

Stream bottoms, wet meadows and ridgetops are generally as described in Mealey et al. (1977). Burns are probably important to grizzlies primarily when they occur in the AF/Vagl habitat type. Forested and grassland/shrubland habitat types and communities are as described in Pfister et al. (1974), Mueggler and Handl (1974) and Cooper (1975).

The following summary is after Mealey (1977), Craighead and Craighead (1972) and Cole (1972). The general feeding cycle follows plant phenology. During the pre-growing season, April to the last of May, many grizzlies appear to be primarily meat eaters. They congregate on ruminant wintering areas and take any animal material available as carrion and kill vulnerable individuals. In addition, corms and roots in the valley/plateau grassland/herblands, and pine nuts in habitat types with whitebark pine are eaten prior to and during early green-up. During the growing season, in late May, June, July and August, grasses, sedges, forbs and rodents are used almost exclusively as food.

GRIZZLY USE AND PLANT PHENOLOGY



The first use of grasses and sedges occurs in late May in south or southwest facing grassland/herblands, snow-free meadows and riparian edges. Use of herbs, primarily grass, as the most important food, reaches high levels in June, peaks in late July and extends through early September. Succulent vegetation is preferred and its availability, linked with that of rodents, influences grizzly distribution. During normal precipitation years, most herbaceous food plants in mesic situations in grassland/herblands and the S/Eqar, S/Gatr, AF/Gatr and AF/Caca forested habitat types remain succulent throughout summer months. As a result, grizzlies are widely distributed with respect to these foods. They feed primarily in open areas having adjacent cover. During the post-growing season, September to denning, grasses and forbs remain important foods but their use is confined to moist sites usually in small forest openings and edges, stream bottoms and wet meadows, and distribution is more narrowly restricted to them. Pine nuts, roots, corms, fruits, berries, and mushrooms (Russula spp.) become available in ridgetops and alpine and subalpine areas. Use of these areas and the AF/Vagl, AF/Vasc/Pial and WBP forested habitat types increases as grasses, sedges and forbs desiccate in grassland/herblands. Predation on male, breeding elk (Cervus canadensis nelsoni) also occurs.

Grizzlies appear adapted primarily to the most constant and abundant food energy source in their environment: protein from succulent herbs and animal material from open fertile grass/herblands with adjacent cover.

Grizzlies are active day and night during early spring when food is relatively scarce. In summer, with relative food abundance, they rest during daylight hours and feed at night. In autumn with food again relatively scarce, they forage intermittently day and night (Craighead and Craighead, 1972). During wet years with a high abundance and availability of succulent vegetation as food, grizzlies are not likely to be highly visible during summer because most feeding and resting probably occurs at night or under the cover of forest canopy. During dry years, bears are likely to be more visible during summer because succulent vegetation is more limited and more time is necessary for foraging in open areas for roots, corms, rodents and vegetation.

Food Plant Ecology

Grizzly food plants, as a group, are generally perennials with high survivability under natural conditions. Many are "hydrophytic" (water-loving) and occupy very wet sites which generally assures stable moisture supplies and abundant growth. Others are "geophytic" (ground-loving) and are either deep or fleshy rooted or both. This assures stable annual growth patterns through storage of high levels of energy and protection from erosion and drought. Many food plants are both hydrophytic and geophytic and are adapted to withstand most naturally occuring disturbances such as wildfire, temporary water shortages, and grazing. As a result, they are stable food sources.

Most of the more important herbaceous grizzly food plants listed in Tables 1 and 2 are also listed by the USFS (1969) as desirables or species of undisturbed or climax plant communities. Desirables are usually good forage plants and are the first to show effects of heavy domestic livestock grazing and other unnatural disturbances. In cases of severe disturbances, especially those which unnaturally affect soil, desirables are usually replaced by intermediates and least desirables (op. cit.). With few exceptions desirables are deep-rooted, provide good ground cover, and reduce soil movement (op. cit.).

Shrubs listed in Tables 1 and 2 as grizzly food species occur as components of both seral and climax plant communities and are highly intolerant of and vulnerable to severe man-caused soil disturbances.

Land Use Implications For Grizzly Foods

Fire Management - As indicated, most grizzlies west of the continental divide appear to derive most of their energy from the fruits of shrubs, primarily huckleberry, buffaloberry and mountain ash. Burns resulting from wildfires in this century are the primary producers of important fruiting shrubs and appears to be the most important source of grizzly food energy. In most of the region, burns are probably the single most important grizzly habitat component.

Lightning caused fires are estimated to occur on the average at least once a century in any given part of the northern U.S. Rocky Mountains west of the divide (Arno, 1977). This natural fire frequency appears necessary to maintain or expand the burn component. Controlled or managed burning in habitat types which are not suitable for timber production above 5,800 feet elevation could approximate a natural fire frequency (Mealey et al., 1977; Erickson, 1976). The WBP/AF, AF/Luhi/Mefe, AF/Luhi/Vasc, and AF/Xete/Vagl forested habitat types could be considered for treatment. The AF/Vagl habitat type in the Yellowstone area east of the divide could also be considered for treatment. Fire management planning including such measures could facilitate grizzly habitat maintenance and improvement.

Timber Harvest - In grizzly range west of the divide in the AF/Clun/Mefe habitat type, timber harvest, especially partial cuts and clearcuts with no dozer-piling of slash and no mechanical soil scarification, produce important amounts of shrubs bearing fruits eaten by grizzlies (Mealey et al., 1977). Production of grizzly food species is greater than in uncut sites in the same habitat type. This indicates that certain timber harvest practices can be applied in some commercial forest stands causing their grizzly food value to increase. Composition and coverage of grizzly food species in clearcuts which have been broadcast burned and are without extensive soil scarification are comparable to those of the natural burn component. This indicates that such man-made openings can become the vegetative equivalents of burns (op. cit.).

Grizzly habitat west of the divide can probably be expanded or enhanced by creating high food producing openings in low grizzly food producing commercial forest habitat types below 5,800 where normal grizzly use appears light. Habitat types and series for consideration are AF/Clun/Mefe, AF/Clun/Xete, AF/Clun/Clun, AF/Clun/Arnu, AF/Opho, and the Thuja and Tsuga series (op. cit.). Ease of the divide in the Yellowstone Park region, the AF/Vagl habitat type could be considered for treatment.

Group selection cuts and small (10-20 acres) irregularly shaped clearcuts in which prescribed fire is used to duplicate wildfire treatment appear desirable for creating high grizzly food producing openings. Desirable clearcut features include one or more leave or cover patches in larger cuts, minimum soil scarification (20 percent or less, preferably in a strip configuration) and slash disposal by broadcast burning or possibly no slash disposal. Yarding methods should minimize soil disturbance. Public access to harvest areas during and after treatment should be managed to minimize the potential for disturbance of grizzlies. Disturbance resulting from unmanaged road use could negate the habitat improvement value on man-made openings (op. cit.; Erickson, 1976).

West of the divide, timber harvest in the high food producing, low commercial value forest habitat types above 5,800 feet elevation appears to damage grizzly habitat by interfering with herbs and shrubs (western sweetroot and huckleberry) in most micro-sites. The main habitat type affected is AF/Luhi/Mefe which has a slow disturbance recovery rate due to cold, severe climate. Below 5,800 feet, clearcuts in the AF/Clun habitat types where slash has been dozer piled and more than one-third of the surface soils have been machine scarified appear to be very poor grizzly habitat. The extensive soil disturbance on these sites resulting from dozer slash piling and soil scarification appears to have destroyed or delayed the establishment of plants which provide grizzly food and cover (Mealey et al., 1977).

Livestock Grazing - Most herbaceous grizzly food plants are also listed as forage plants for domestic livestock (USFS, 1969). Domestic livestock, using grazing allotments in grizzly habitat, show highest preferences for components and foods important to grizzlies (Mealey et al., 1977; Schallenberger, 1976). Important components are wet meadows, stream bottoms, aspen groves and avalanche chutes with their succulent grasses, sedges and forbs (op. cit.).

Domestic livestock graze in the important wet components with much greater efficiency than that of grizzlies; they also occur in greater densities in these preferred feeding sites thus consuming more forage and causing far greater on-site physical alterations through, for example, trampling. As a result of these factors, livestock use can remove critically important food production areas from grizzlies (op. cit.). Management programs for domestic livestock grazing in grizzly habitat should reflect the potential for food competition between grizzlies and livestock. They should also reflect the ability of livestock to win such competition. Domestic livestock grazing should be managed to protect important grizzly foods and the habitat components which produce them.

Mineral Exploration, Road Construction and Recreation - These activities combined have the potential for physical site alteration and increased human activity in grizzly habitat. Both of these effects can be undesirable with respect to grizzlies in that (1) grizzly-human conflict potential may be increased, (2) human presence may interfere with grizzly use of important habitat components while not altering the components physically, and (3) physical alteration of components may occur which could negate their value to grizzlies.

Any proposals for the above human use activities should take into account the occurrence of important grizzly habitat components in or near proposed use areas. Highest potential for human-grizzly conflicts exists when human activities are superimposed on or near areas providing for essential grizzly needs. Therefore, it should be assumed that avoidance of such superimposition would reduce conflict potential. Principles applying to physical site alterations would be generally the same as those discussed under timber harvest and livestock grazing, e.g., soil scarification, forage removal and other human activities in or near prime grizzly use areas that could promote human/grizzly encounters should be minimized.

Cover

Cover is a combination of vegetative and topographic features which provide for the grizzly's security and denning needs. Considerations of den site location requirements will not be emphasized in this methodolgy because of ambiguity in current scientific understanding. For example, Craighead and Craighead (1972) found indications that bears prefer northerly exposures, but recent data (Knight, 1977; Jonkel et al., 1977) from other studies in different locations indicate that other exposures and less isolated areas are used. However, all known den sites are in areas that normally receive heavy snowfall (Knight, 1977; Craighead and Craighead, 1972).

Although the grizzly probably evolved in open or non-forested areas and appears to be behaviorally (Herrero, 1972) and nutritionally (Mealey, 1977) adapted to them, optimum habitat appears to include extensive timbered areas which presumably provide security cover (Knight et al., 1976; Craighead and Craighead, 1972) adjacent to or continuous with grassland/herbland, shrubland or other open-site feeding areas. Whether required or not, timbered areas are where grizzlies spend most of their time, at least when not feeding. Most winter dens, and daybeds used for resting between feeding periods, are located in thickets of spruce, fir and lodgepole pine (Craighead and Craighead, 1972). Personal observation indicate that daybeds are nearly always located in relatively open timber stands immediately adjacent to open area feeding sites. Such open stands provide adequate day cover for the apparent reasons that daybeds are shallowly excavated (1-18 inches) thus lowering the individual's profile and normal grizzly coloration blends well with normal understories.

Space

Space is a species' communal home territory, the size of which is determined by the cruising radius of the species. This home territory must contain all of the species' requirements - food, cover and water, for both sexes and all age classes, for all seasons and for all the species' activities (King, 1938). In general, the amount of space used by a population or individual in any given habitat appears to be primarily a function of interspersion of types, or the arrangement in any given area, of food, cover and water which meet all the animal's physical and behavioral needs. In the case of grizzlies, the more compact and efficient the arrangement of necessary components, the smaller the amount of space used. Home range sizes vary from an average area of 5.5 square miles on Kodiak Island where salmon, berries, riparian vegetation and denning sites are closely grouped (Berns and Hensel, 1972) to an average area of 41.9 square miles in Yellowstone Park (Craighead and Craighead, 1972; Erickson, 1976) where seasonal habitat components are widely separated.

In the northwestern U.S. south of Canada, the amount of space used by grizzlies appears to be directly related to the interspersion of habitat components and vegetative diversity within the different habitats. Individual grizzlies in northwestern Montana on the Flathead National Forest appear to use far less space than grizzlies east of the divide in and around Yellowstone Park. Standard diameters computed on entire home ranges of grizzlies west of the divide compare only to relatively small areas of seasonal grizzly activity east of the divide (Knight, 1977; Jonkel et al. 1977). In some cases home ranges in the Yellowstone area appear to be 3-4 times greater than on the Flathead National Forest. Grizzly range west of the divide, where grizzlies use less space, has a moist, maritime climate and steep precipitatous terrain. These conditions appear to account for the high type interspersion and high ecological and vegetative diversity (more diverse habitat types and components compacted into smaller areas) characteristic of the area. By comparison, grizzly range in the Yellowstone area, where grizzlies use more space, has a much drier continental climate and more uniform relief with much of the area dominated by broad, undulating plateaus. As a result, interspersion of types and vegetative diversity appear much less. For example, only six forested habitat types of apparent importance to grizzlies exist east of the divide, while west of the divide there are twelve important types (Tables 1 and 2).

Regardless of home range size, space or home territory must contain all of the different types of cover and the various kinds of foods needed during the different seasons for the various activities of the several age classes in the population (King, 1938). In the Yellowstone area, and elsewhere along the continental divide, this includes ruminant wintering grounds, early spring green-up areas, wet meadows, grassland/herblands, alluvial bottoms and parklands, hydric forested areas, WBP timber types, talus slopes, wet avalanche chutes and high alpine/subalpine ridgetops. All of these components will be dispersed over large areas. West of the divide the components will be sidehill parks, avalanche chutes, burns, wet meadows, stream bottoms, ridgetops and mesic and hydric forested types all interspersed in smaller areas.

Behavior

Behavior is the manner or way in which a species, population or individual conducts its activities. Apparent natural or pristine grizzly behavior usually is expressed through a total dependence upon natural foods under free-ranging conditions. This normally means that bears are not adapted to contacts with man and usually flee from him under most circumstances. Human-grizzly conflict potential is usually low.

Grizzlies that forage on human food, garbage, crops or livestock in close proximity to people become habituated to people (Herrero, 1976). This modified behavior increases grizzly-human conflict potential which threatens both human safety and grizzly bear preservation.

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APPENDIX

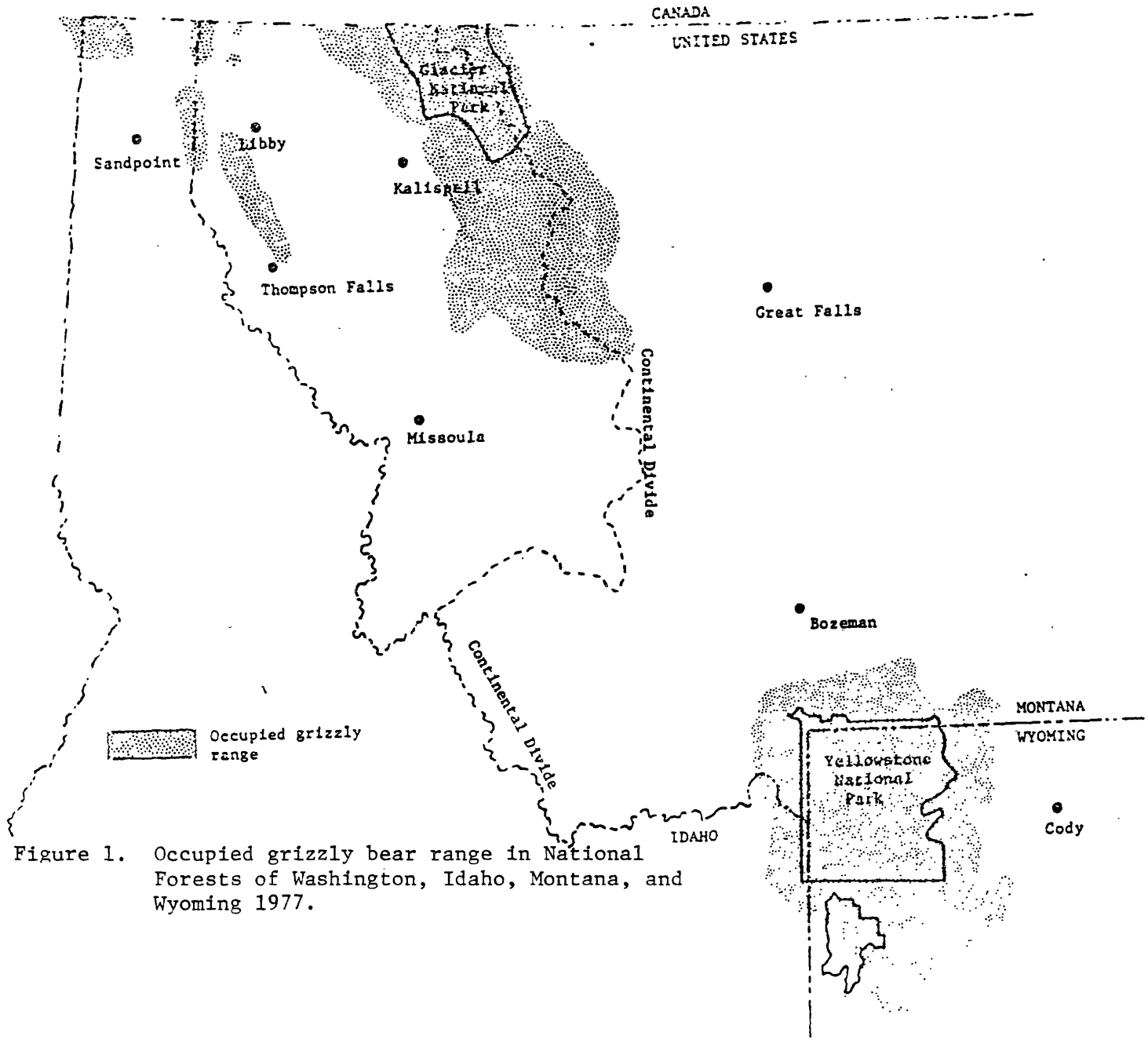


Figure 1. Occupied grizzly bear range in National Forests of Washington, Idaho, Montana, and Wyoming 1977.

TABLE [redacted] GRIZZLY BEAR FOOD USE, FOOD SPECIES, AND HABITAT COMPONENTS WEST OF THE CONT[redacted] DIVIDE IN NORTHWESTERN MONTANA AND NORTHERN IDAHO AS THEY APPEARED IN 1975 AND 1976.

Food Use[1]					
Food Items	Use	Importance Value %	Grizzly Food Species[2]	Grizzly Habitat Components[3]	
Fruits and Berries		46.0	**Trees**	**Non-forested Areas**	
	Vaccinium globulare 39.8		*Pinus albicaulis*	Avalanche Chutes	
	Sorbus spp. 22.2		**Shrubs**	Stream Bottoms	
	Shepherdia canadensis 11.9		*Amelanchier alnifolia*	Wet Meadows	
	Arctostaphylos uva ursi 10.1		*Arctostaphylos uva ursi*	Burns	
	Cornus stolonifera 5.7		*Cornus stolonifera*	Sidehill Parks	
	Vaccinium scoparium 2.0		*Lonicera involucrata*	Ridgetops	
	Rhamnus alnifolia 2.0		*Lonicera utahensis*		
	Disporum trachycarpum 1.5		*Ribes* spp.	**Forested Habitat Types**	
	Rosa spp. 1.5		*Rosa* spp.	(Mesophytic herb understory)	
Grass and Sedge	Stems and leaves	27.7	*Salix* spp.	AF/Caca *(Abies lasiocarpa/Calamagrostis canadensis)*	
Umbelliferae	Stems and leaves	13.0	* *Shepherdia canadensis*	AF/Luhi/Mefe *(Abies lasiocarpa/Luzula hitchcockii/ Menziesia ferruginea)*	
Equisetum arvense	Stems	4.0	* *Sorbus* spp.	AF/Clun/Mefe *(Abies lasiocarpa/Clintonia uniflora/ Menziesia ferruginea)*	
Formicidae		2.0	* *Vaccinium globulare*	AF/Clun/Arnu *(Abies lasiocarpa/Clintonia uniflora/ Aralia nudicaulis)*	
Roots	Umbelliferae and *Erythronium grandiflorum*	1.0	*Vaccinium scoparium*	S/Clun/Clun *(Picea/Clintonia uniflora/Clintonia uniflora)*	
			Vaccinium caespitosum	WRC/Clun/Clun *(Thuja plicata/Clintonia uniflora/ Clintonia uniflora)*	
Trifolium spp.	Stems and leaves	1.0	**Forbs and Ferns**		
Taraxicum spp.	Stems and leaves	1.0	*Angelica* spp.	(Mesophytic fruiting shrub understory)	
Pinus albicaulis	Nuts	1.0	*Aralia nudicaulis*	AF/Xete/Vagl *(Abies lasiocarpa/Xerophyllum tenax/ Vaccinium globulare)*	
Miscellaneous		1.3	*Astragalus robbinsii*	AF/Libo/Xete *(Abies lasiocarpa/Linnaea borealis/ Xerophyllum tenax)*	
			Castellija spp.	DF/Xete/Vagl *(Pseudotsuga menziesii/Xerophyllum tenax/ Vaccinium globulare)*	
			* *Claytonia* spp.	AF/Clun/Xete *(Abies lasiocarpa/Clintonia uniflora/ Xerophyllum tenax)*	
			Circium spp.	AF/Xete/Vasc *(Abies lasiocarpa/Xerophyllum tenax/ vaccinium scoparium)*	
			Disporum trachycarpum		
			Equisetum arvense	(Xeric - Pine nuts and starchy-rooted forbs)	
			Erythronium grandiflorum	WBP/AF *(Pinus albicaulis/Abies lasiocarpa)*	
			Fragaria spp.		
			Fritillaria pudica		
			Hedysarum spp.		
			* *Heracleum lanatum*		
			Lomatium spp.		
			Ligusticum spp.		
			Osmorhiza occidentalis		
			Polygonium bistortoides		
			Polypodiaceae		
			Ranunculus spp.		
			Rumex spp.		
			Senecio triangularis		
			Smilacina spp.		
			Taraxicum spp.		
			Trifolium spp.		
			Veratrum viride		
			Graminoids		
			* *Carex* spp.		
			* Graminae		
			Melica spectabilis		
			Mammal and Insect		
			Cervidae		
			Ursidae		
			Rodentia		
			Formicidae		

[1]From: Husby *et al.* (1977).

[2]From: Husby *et al.* (1977), Mealey *et al.* (1977), Martinka (1972), Tisch (1961).

[3]From: Mealey *et al.* (1977), Erickson (1976), Erickson (1975), Pfister *et al.* (1974), Martinka (1972), Jonkel and Cowan (1971), Tisch (1961).

*Foods of primary importance.

TABLE 2. GRIZZLY BEAR FOOD USE, FOOD SPECIES, AND HABITAT COMPONENTS IN ALPINE AREAS AND AREAS ALONG AND EAST OF THE CONTINENTAL DIVIDE IN MONTANA AND NORTHWESTERN WYOMING AND ADJACENT ENVIRONS AS THEY APPEARED DURING THE PERIOD 1973-1976.

Food Use[1]				
Food Item	Use	Importance Value %	Grizzly Food Species[2]	Grizzly Habitat Components[3]
Grass and Sedge		78.5	Trees	Non-forested Areas
	Grass 95%		*Pinus albicaulis*	Valley/plateau grassland/herbland**
	Sedge 5%		Shrubs	Subalpine grassland/herbland***
Claytonia lanceolata	Entire	6.1	*Amelanchier alnifolia*	Alpine herblands
Cirsium foliosum	Stems and heads	4.4	*Arctostaphylos uva ursi*	Stream Bottoms
Trifolium repens	Stems and leaves	2.4	*Cornus stolonifera*	Wet Meadows
Salmo clarki	Entire	1.7	*Lonicera involucrata*	Burns
Umbelliferae	Roots	1.7	*Lonicera utahensis*	Ridgetops
	Perideridia gairdneri 54%		*Ribes* spp.	Talus Slopes
	Lomatium cous 46%		*Rosa* spp.	Avalanche Chutes
Rodentia	Entire	1.3	*Shepherdia canadensis*	Forested Habitat Types
	Thomomys talpoides 63%		*Sorbus* spp.	(Mesophytic herb understory)
	Microtus spp. 35%		*Vaccinium globulare*	S/Eqar (*Picea/Equisetum arvense*)
	Marmota flaviventris 2%		*Vaccinium scoparium*	S/Catr (*Picea/Galium triflorum*)
Cirvidae/Bovidae	Entire	1.3	Forbs and Ferns	AF/Gatr (*Abies lasiocarpa/Galium triflorum*)
	Cervus canadensis 90%		*Angelica* spp.	AF/Caca (*Abies lasiocarpa/Calamagrostis canadensis*)
	Odocoileus hemionus 6%		* *Claytonia* spp.	
	Bison bison 4%		* *Cirsium foliosum*	(Mesophytic fruiting shrub unstory)
Melica spectabilis	Corms	.75	*Equisetum arvense*	AF/Vagl (*Abies lasiocarpa/Vaccinium globulare/Vaccinium globulare*)
Equisetum arvense	Stems	.51	*Erythronium grandiflorum*	(Xeric - pine nuts and starchy-rooted forbs)
Pinus albicaulis	Nuts	.48	*Fragaria* spp.	AF/Vasc/Pial (*Abies lasiocarpa/Vaccinium scoparium/Pinus albicaulis*)
Vaccinium scoparium	Berries	.37	*Fritillaria pudica*	WBP/Vasc (*Pinus albicaulis/Vaccinium scoparium*)
			Heracleum lanatum	
			* *Lomatium* spp.	Other Forested Communities
			Ligusticum spp.	Aspen and associated grasslands
			Osmorhiza occidentalis	
			* *Perideridia gairdneri*	Grassland/Shrubland Habitat Types
			Polygonium bistortoides	Associated with Non-Forested Areas
			Polypodiaceae	
			Ranunculus spp.	** Feid/Deca - (*Festuca idahoensis/Deschampsia caespitosa*)
			Rumex spp	Feid/Agca - (*Festuca idahoensis/Agropyron caninum*)
			Senecio triangularis	Fesc/Agsp - (*Festuca scabrella/Agropyron spicatum*)
			Smilacina spp.	Fesc/Feid - (*Festuca scabrella/Festuca idahoensis*)
			Taraxicum spp.	Arca/Feid - (*Artemisia cana/Festuca idahoensis*)
			* *Trifolium* spp.	Pofr/Fesc - (*Potentilla fruticosa/Festuca scabrella*)
			Veratrum viride	
			Graminoids	*** Deca/Carex - (*Deschampsia caespitosa/Carex* spp.)
			* *Carex* spp.	Feid/Deca - (*Festuca idahoensis/Deschampsia caespitosa*)
			* Graminae	
			Melica spectabilis	
			Animal and Insect	
			* Cervidae	
			Ursidae	
			* Rodentia	
			Formicidae	
			Pisces	

[1]From: Mealey (1977).

[2]From: Mealey (1977), Sumner and Craighead (1973), Craighead and Craighead (1972), Hornocker (1962), Murie (1944).

[3]From: Craighead *et al.* (1976), Knight *et al.* (1976), Mealey (1976), Schallenberger (1976), Mealey (1977). Knight *et al.* (1975), Cooper (1975), Mueggler and Handl (1974), Pfister *et al.* (1974), Sumner and Craighead (1973), Craighead and Craighead (1972), Hornocker (1962).

*Foods of primary importance.

FORM-1. GRIZZLY BEAR HABITAT QUALITY AND CONSEQUENCE ANALYSIS EVALUATION MASTER.

Slope: _____ Aspect: _____ Elevation: _____

No. _____, Habitat Component/Type: _____ Impact Area: _____ % of Impact Area: _____ Proposed Use: _____

	Spring Evaluation Date:							Summer Evaluation Date:							Autumn Evaluation Date:						
	P-1	P-2	P-3	P-4	P-5	AVG. and TOT.	CAR[6]	P-1	P-2	P-3	P-4	P-5	AVG. and TOT.	CAR[6]	P-1	P-2	P-3	P-4	P-5	AVG. and TOT.	CAR[6]
Food Groups																					
1) Succulent Herb Tops "Mesophytes"																					
Graminae																					
Carex spp.																					
Claytonia lanceolata																					
Circium foliosum																					
Trifolium spp.																					
Equisetum arvense																					
Angelica spp.																					
Heracleum lanatum																					
Ligusticum spp.																					
Osmorhiza spp.																					
Polypodiaceae																					
Ranunculus spp.																					
Rumex spp.																					
Senecio triangularis																					
Taraxicum spp.																					
Veratrum veride																					
	Sub. Tot. Coverage							Sub. Tot. Coverage							Sub. Tot. Coverage						
2) Starchy Herb Roots "Geophytes"																					
Lomatium spp.																					
Perideridia gairdneri																					
Claytonia spp.																					
Erythronium grandiflorum																					
Fritillaria pudica																					
Polyogonium bistortoides																					
Smilacina spp.																					
Astragalus spp.																					
Hedysarum spp.																					
Melica spectabilis																					
	Sub. Tot. Coverage							Sub. Tot. Coverage							Sub. Tot. Coverage						
3) Fleshy fruit-bearing Shrubs/Herbs																					
Vaccinium globulare																					
Vaccinium scoparium																					
Vaccinium caespitosum																					
Sorbus spp.																					
Shepherdia canadensis																					
Amelanchier alnifolia																					
Arctostaphylos uva ursi																					
Cornus stolonifera																					
Lonicera involucrata																					
Lonicera utahensis																					
Ribes spp.																					
Rosa spp.																					
	Sub. Tot. Coverage							Sub. Tot. Coverage							Sub. Tot. Coverage						

VERBAL STRATIFICAT

Objective: Provide a verbal rational of each probable effect. should be answered: Will long-term? Do alternativ be reversible with or wit mitigation measures; and Explanations must be give will be positive, negativ

1. Food CAR Stratification:

2. Cover CAR Stratification:

3. Space CAR Stratification:

4. Behavior CAR Stratification:

Other Comments, Continued:

)N OF CONSEQUENCES

for each CAR. Explain the magnitude
'or example, the following questions
the effect likely be short-term or
components exist? Will the effect
)ut mitigation? What are feasible
ll a significant area be affected?
of the extent to which an effect
or neutral.

FORM 2. GRIZZLY BEAR HABITAT QUALITY AND CONSEQUENCE ANALYSIS EVALUATION MASTER, SPACE AND BEHAVIOR.

No. _____, Impact Area: _____, Proposed Use: _____

	Space		Behavior	
	SHQR	CAR*	BHQR	CAR*
Spring	_____		_____	
Summer	_____		_____	
Autumn	_____		_____	

Comments:

*Give verbal rationale for each CAR on Form 3.

FORM 3. VERBAL STRATIFICATION OF CONSEQUENCES

Objective: Provide a verbal rationale for each CAR. Explain the magnitude of each probable effect. For example, the following questions should be answered: Will the effect likely be short-term or long-term? Do alternative components exist? Will the effect be reversible with or without mitigation? What are feasible mitigation measures; and will a significant area be affected? Explanations must be given of the extent to which an effect will be positive, negative or neutral.

1. Food CAR Stratification:

2. Cover CAR Stratification:

3. Space CAR Stratification:

4. Behavior CAR Stratification:

Other comments, Continued:

FORM 4. GRIZZLY BEAR ACTIVITY REPORT.

Date: Time: Observer:

Source of information:

Activity type: Actual grizzly _____; Track _____;

Scat _____; Digging _____; Hair _____;

Other _____;

Description: (age, number, color, size, volume, contents, activity, etc.)

Location:

Vegetation:

Habitat component or type:

Topography: (terrain, elevation, aspect, etc.)

FORM 5. BEAR SIGHTING AND/OR IDENTIFICATION REPORT.

I. Sighted by_____ Address_____

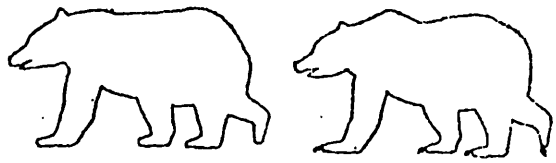
II. Sighting date_____ Time_____

III. Sighting location_____

IV. Description of bear(s):

A. Species:

	As reported	verified by--
Grizzly	☐	☐
Black	☐	☐
Unknown	☐	☐



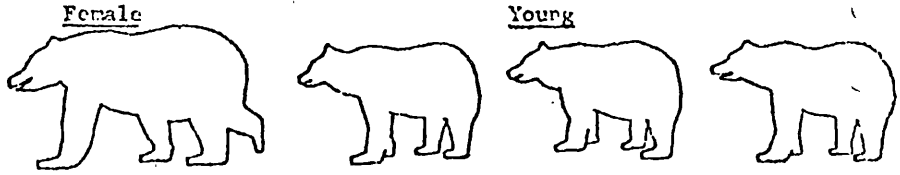
B. Number of bears seen by size and coat color:
(also describe any identifying eartags or markers)

Predominant coat color: Weight in pounds--

	10-50	50-100	100-200	200-400	Over 400
1 - black					
2 - reddish-brown					
3 - gray					
4 - dark brown (chocolate)					
5 - light brown (tan)					
6 - blonde (white-yellow)					
7 -					

C. Diagram coat color pattern of female/young groups only, using colors 1 to 7 above.

Female Young



D. Activities of bear(s): Preying on_____ Scavenging on_____
Digging_____ Grazing_____ Other_____

V. Report filled out by_____
at (location)_____ on (date/time)_____

Notified (date/time):

Dist. Ofc._____

Cubs-of-year are usually less than 1/4 of female size, or 10-50 lbs;
Yearlings, 1/4-1/2 of female size, or 50-100 lbs.
2-year-olds, 1/2-3/4 of female size, or 100-200 lbs.
Small adult bears are 100-200 lbs; medium adults, 200-400 lbs; large adults, 400+ lbs.

FORM 6. GRIZZLY BEAR HABITAT QUALITY AND CONSEQUENCE ANALYSIS SCORECARD.
No. _____, Habitat Component or Type _____, % of Impact Area _____

	Food		Cover		Space		Behavior		Season
	FHQR	CAR	CHQR	CAR	SHQR	CAR	BHQR	CAR	Summary
Spring									
Summer									
Autumn									
Important Ruminant, Rodent or Fish Area									
Suspected or Known Den Sites									
Annual Summary									

Comments:

SURVEY CHECKLIST

I. Before Data Collection:

---Off-site procedures---(Office)

1. Delineate Extensive Survey Area on 1:62,500 USGS Map.

   a) Get a general overview.

2. Delineate Intensive Survey Area on 1:23,674 USGS Map.

   a) Get specific information on proposed land use and grizzly use.

3. Delineate Primary and Secondary Impact Areas of 1:23,674 USGS Map.

   a) Obtain and accurately map locations of all habitat components and other habitat types and all prominent geophysical features.

4. Establish General Sampling Strategy.

   a) Determine plot numbers and locations.

   b) Establish sampling schedule.

---On-site procedures---(Field)

5. Refine 1-4 above as necessary to reflect actual situations on the ground.

II. Data Collection:

1. Evaluate food and cover using sample plots. Five plots are sampled in each habitat component or other habitat type present in each impact area. Use appropriate conversion and value systems in footnotes on Form 1. Photograph plots each sample period (spring, summer, autumn) to document phenological changes.

2. Evaluate behavior and spatial use, using impact areas as points of reference.

3. For food and cover, estimate consequences of effects on sample groups as a whole or components or types represented by them rather than on individual plots. For behavior and spatial use, estimate effects on impact areas.

4. Stratify consequences verbally.

III. Data Analysis:

1. Analyze data from perspective of trends rather than totals.

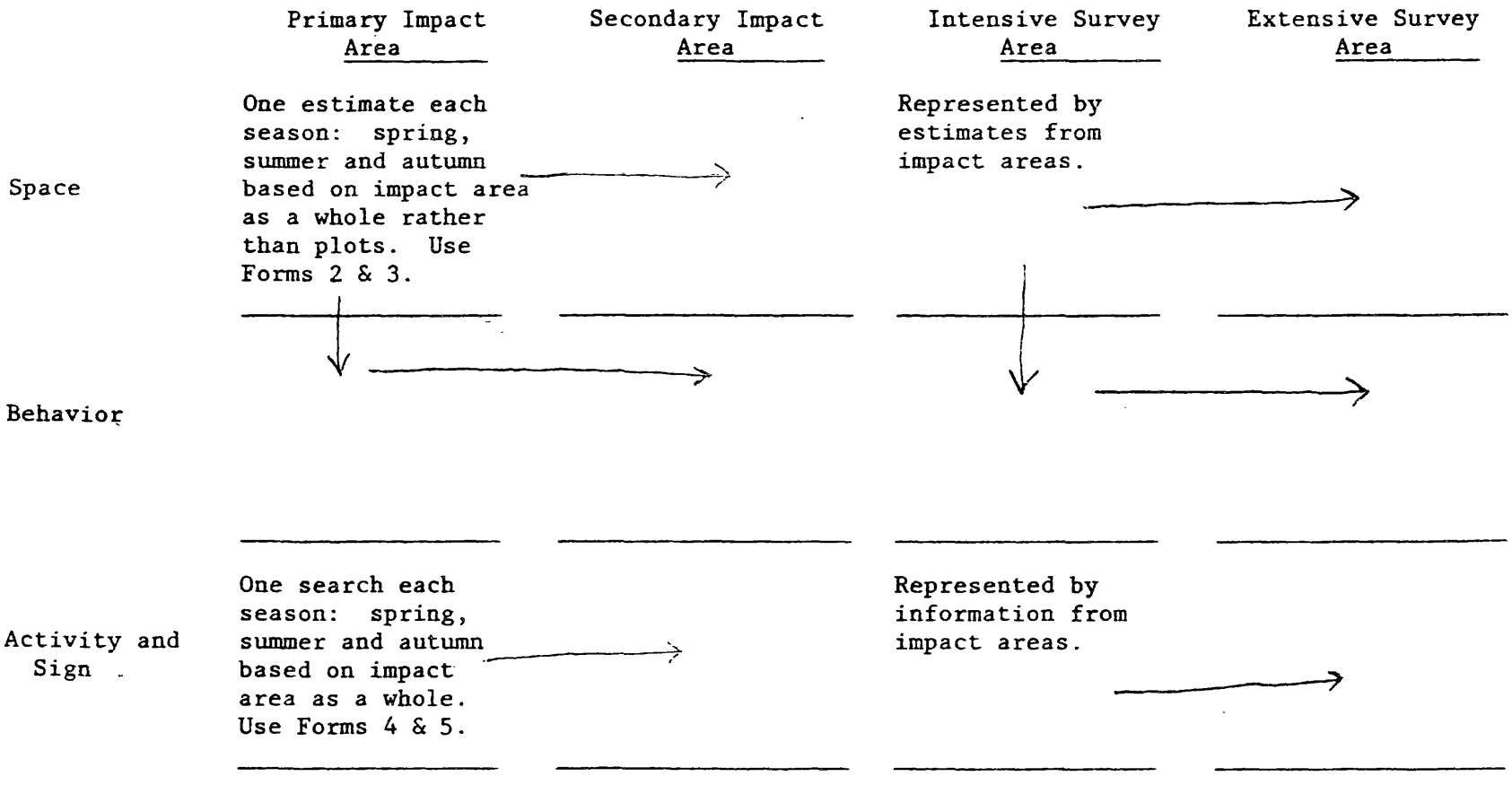
DATA COLLECTION PROCEDURE SUMMARY

	Primary Impact Area	Secondary Impact Area	Intensive Survey Area	Extensive Survey Area
General Requirements	Refined mapping of vegetation by habitat type. Refined mapping of Grizzly use areas including habitat components and important topographic features. Mapping of proposed land use impact zone. Highlight areas of overlap.		Analyses of appropriate materials to gain specific information about grizzly habitat, vegetation and terrain. Mapping of grizzly habitat and area affected by proposed land use.	Off-site analyses of aerial photos, maps and records to gain general overview of of grizzly status, vegetation, terrain and land use history.
Food	Sample five plots in each grizzly habitat component and each other habitat type present. Plots sampled spring, summer and autumn. Use Forms 1 & 3.		Represented by samples from impact areas.	
Cover	Same plots used to sample food provide cover data. Use Forms 1 & 3.			

DATA COLLECTION PROCEDURE SUMMARY

	Primary Impact Area	Secondary Impact Area	Intensive Survey Area	Extensive Survey Area
General Requirements	Refined mapping of vegetation by habitat type. Refined mapping of Grizzly use areas including habitat components and important topographic features. Mapping of proposed land use impact zone. Highlight areas of overlap.	→	Analyses of appropriate materials to gain specific information about grizzly habitat, vegetation and terrain. Mapping of grizzly habitat and area affected by proposed land use.	Off-site analyses of aerial photos, maps and records to gain general overview of of grizzly status, vegetation, terrain and land use history.
Food	Sample five plots in each grizzly habitat component and each other habitat type present. Plots sampled spring, summer and autumn. Use Forms 1 & 3.	→	Represented by samples from impact areas.	→
Cover	Same plots used to sample food provide cover data. Use Forms 1 & 3.	→	↓	→

DATA COLLECTION PROCEDURE SUMMARY (Continued)


Primary Impact Area
Secondary Impact Area
Intensive Survey Area
Extensive Survey Area
Space
Behavior
Activity and Sign
One estimate each season: spring, summer and autumn based on impact area as a whole rather than plots. Use Forms 2 & 3.
Represented by estimates from impact areas.
One search each season: spring, summer and autumn based on impact area as a whole. Use Forms 4 & 5.
Represented by information from impact areas.

* If a habitat component or other habitat type is continuous throughout both impact areas, it is sampled with only one five plot group distributed through both impact areas.

AREA DETERMINATION ON A

1/10 ACRE PLOT